Results and Conclusion

Black hole space-times are probably the most fascinating objects whose existence is predicted by Einstein’s general theory of relativity. The uniqueness and the no hair theorems give strong restrictions on the possible signatures one could look for in astrophysical observations. During the last forty years, numerous mathematical studies have been made in order to understand their properties. In this thesis we have concentrated on the scattering aspect of certain black hole space-time. Following are the main conclusions of this thesis.

1. We have studied the scattering effect of scalar waves in Schwarzschild-de Sitter (SdS), RN extremal and SdS extremal space-times. We have derived expressions for absorption cross sections in the low energy limit for these black hole space-times. Using the property of reflection of waves from horizon, we have obtained expression for the Hawking temperature of SdS black hole and found that for this case the absorption cross section inversely depends on Hawking temperature.

2. We have obtained the expression for absorption cross section of Reissner-Nordstrom black hole, perturbed by charged scalar wave. Here the absorption cross section depends inversely on square of the Hawking temperature. We also find the fact that
the absorption cross section is found to be decreasing if the charge of RN black hole is increasing.

3. The scattering of Dirac waves in a Schwarzschild space-time in the low energy limit is also studied. The absorption cross section of Schwarzschild black hole in Dirac field is found to be 1/8th of absorption cross section of Schwarzschild black hole in scalar field. And the absorption cross section for $k = 2$ in Dirac field is also derived. By plotting the emission spectrum of Schwarzschild black hole in Dirac field with and without reflection we find that the main contribution for the emission spectra comes from the $k = 1$ case, and the higher modes have negligible effect.

4. Using WKB approximation we have evaluated quasi-normal mode frequencies of Schwarzschild, RN extremal, SdS and near extremal SdS black hole space-times having cosmic string perturbed by a massless Dirac field. Here quasi-normal modes with higher mode numbers decay faster than the low-lying ones as in the ordinary case. When the imprint of cosmic string is high, $|Im(E)|$ decreases while $Re(E)$ increases for fixed $k$, implying the fact that the presence of cosmic string slows down the decay.

5. The influence of cosmic string on the quasi-normal modes of RN black hole background space-time perturbed by positively and negatively charged Dirac fields is studied. The Pöschl-Teller method is used for finding the quasi-normal modes and found that, when perturbing with the positively charged Dirac field, the decay will be less for Reissner Nordstrom black hole having cosmic string. But when we perturb with negatively charged Dirac field it is found that the cosmic string effect will dominate only in the case of RN black hole having small charge.
When the charge of the black hole is increased effect of cosmic string is suppressed.

**Future prospects**

The gravitational collapse of compact objects to form black holes still remains as not yet a well understood problem in physics. The possibility of detecting gravitational waves from these compact objects in the near future by the LIGO and VIRG laser interferometric detectors has aroused a lot of interest in this topic. It is believed that QNMs carry a unique footprint to directly identify the existence of a black hole. Thus they are expected to play a significant role in the search for gravitational waves and black holes. Furthermore, there are many interesting and deep theoretical questions that one can pose in this situation, some of them are,

1. finding expressions for absorption cross sections of SdS, Reissner-Nordstrom and their extremal cases, perturbed by Dirac field, electromagnetic and Gravitational fields.

2. extending the calculation for finding quasi-normal modes of spherically symmetric black holes having cosmic string perturbed by massive Dirac field and also for rotating black holes.